Studies in Agricultural
Capital and Technology

Economics and Sociology
Occasional Paper No. 185

FARM BUSINESS ANALYSIS AND PLANNING TECHNOLOGY

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July, 1974

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Energy and its preservation has become the worldwide topic of conversation. Availability and cost of fossil fuels has caused the most concern. The more important type of energy to man, however, is not fossil fuels, but energy stored in foodstuffs. The old saying "Man does not live by bread alone - unless there is no bread" is quite applicable. There is a minimal requirement of energy in the form of calories derived from foodstuffs that is absolutely essential for human survival. The history of the world is full of famine, starvation, and ill health due to the lack of this type of essential energy. Fortunately, the process of converting chemicals by radiant and solar energy through photosynthesis in plants is a continual process. Each year energy required for human survival is replenished. The effectiveness of this conversion process depends upon our managerial capabilities.

Personally, I like to define management as the setting of objectives and goals, and the use of obtainable resources in the most optimal manner possible in reaching these objectives and goals. If I may be so presumptious as to state my concept of the overall objective of farm management, I would say that it is to help farmers produce enough food and fiber to meet the minimal requirements of the earth's population. How well we who are involved in farm management are able to combine land, labor, and capital with the photosynthetic process in providing energy for human metabolism will, in a large sense, determine the well-being of mankind. In this we are responsible not only to ourselves, but to our children, grandchildren, and the generations to come. The most effective management of these resources can only come about through the interaction and cooperation of nations, and this cooperation can only be achieved through effective exchange and utilization of information and technology. Proper information, in the proper place, at the proper time, is basic to the management process.

Mr. Bennett, program chairman, asked me to present an overview of farm management techniques in use now and prospects for the future including such items as purchased counselling services, data banks, computer systems, and government advisory services. I have taken the prerogative of limiting my presentation to those management techniques that are computer oriented and with which I have become acquainted over the past ten years. I have also taken the liberty of drawing heavily from information presented at the "*First International Conference on Computer Satellites in Agriculture*" which was held in Columbus, Ohio from October 30 - November 2, 1972. This

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*Keynote address presented at the Second International Farm Management Congress, July 14-19, 1974, at the University of Guelph; Guelph, Ontario, Canada.

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conference brought together a large number of those individuals actively involved in the use of time-sharing computers as aids in agricultural decision making.

COMPUTER SYSTEMS

The development of modern society with its industrial base created the need for efficient methods of data processing. Data processing, a fancy term for paper work, received most of its automation within the past three decades. The first computer in the world was designed and built at the University of Pennsylvania between 1939 and 1946 and was known as the ENIAC (Electronic Numerical Integrator and Calculator). In Europe, the first was completed at Cambridge University in 1949 and was known as the EDSAC (Electronic Delay-Storage Automatic Computer). The first commercially available computer (Univac-1) was installed at the U.S. Census Bureau in 1951, while the first computer for business use (IBM 650) became available in 1954 (27, pp. 2-7)*.

Technological advances and their adaptation over the past twenty years have probably been more rapid and had a greater effect on society than any development in the history of mankind. The major identifying characteristic of the first generation of computers, such as the Univac-1 and the IBM 650, was vacuum tubes. This was the first step from electromagnetic calculating devices to electronics. It became possible to perform computations one thousand times faster than before. Transistors ushered in second generation computers about 1959-60, and solid-logic technology ushered in the third generation in 1964-65. In a period of ten years, the computer industry had advanced from vacuum tubes to solid logic-technology. Computation speeds had increased with each generation computer by a factor of approximately 1000 over the previous generation. The early 1970's has seen the introduction of computer circuitry on silicon chips. Once again this has greatly increased the speed of computers and also reduced the area needed to store information. For an example, in the IBM System/370 series, Model 145, as many as 1434 microscopic elements--transistors, resistors, and diodes--are integrated into 174 circuits on silicon circuit chips less than one-eighth inch square (27, p. 10). The rapid technological advances over the past two decades has effected faster, cheaper, and more reliable data processing. "Computer computation is a great deal less expensive than manual processing, and the accuracy of the machine is, for all practical purposes, perfect. For example, computer computation time equivalent to one man-year of manual calculating costs less than one dollar on the fastest computers." (28, p. 77)

Of special interest to agriculture has been the development of time-sharing. This technology has developed over the past ten years. Time-sharing is a term used to describe a data-processing system that includes

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*Numerals in parenthesis refer to publications in the Bibliography.

both high-speed, online, direct-access storage devices and relatively slow-speed, online, simultaneously usable terminals. The speeds of central processing units have increased to the point that in most cases each user could well believe that he is the only one using the system whereas in reality, he will be sharing the system's resources with many others. In some of the larger modern systems, the others might well be several hundred. Time-sharing works primarily through teleprocessing. Telephone lines, micro-wave radio circuits, and electric cables are common types of lines. In the United States, most agricultural time-sharing is carried out over the standard telephone network. Telephone lines can transport data at speeds of more than three hundred characters per second. Most terminals transmit and receive information over the telephone at 10, 30, 60 or 120 characters per second (9, 11, 17, 24). The most numerous of all "time-sharing" terminals is the lowly Teletype ASR-33 that transmits and receives at 10 characters per second (11, 24). This relatively low speed unit is never-the-less quite sufficient for many types of operations, especially those which do not require transmission of large amounts of information. Terminal technology has advanced considerably over the past five years. Lighter, faster, more capable units are being introduced on a continual basis. The smallest terminal I have seen is the T-16 pocket terminal recently introduced by Interface Systems, Inc. of Ann Arbor, Michigan. This terminal, the size of a pack of cigarettes, acoustically couples to any telephone for remote data entry and inquiry. Computer replies are received through the telephone earpiece. It costs less than $150.

In its broadest sense, time-sharing allows one to access computer programs* and data** banks at any location from any location within seconds. All that is needed is a terminal, a telephone, electrical current, and a contract with the computer center for use of its facilities. From some locations, the telephone toll could be excessive, but from others it is not. Computer companies are continually expanding their communications networks to make their facilities available to customers at no additional communication costs. A concept known as "multiplexing" allows practically full use of the potential data transmission capability of a communication line. One telephone line, for example, can transmit the communications between the computer and several terminals simultaneously if a multiplexor is used. This technology greatly reduces the costs of communications within a time-sharing system. Probably the most extensive time-sharing system is that of Honeywell/General Electric wherein customers throughout Europe, Japan, and the United States can dial "local" telephone numbers and all be accessing the same computer at General Electric's computer system in Cleveland, Ohio, U.S.A. General Electric markets the system in the United States and Honeywell in Europe (4).

The practicality of "Mini and Micro" computer systems is now being realized. A large amount of computer power and capability can be provided in

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*Computer Program: A sequence of instructions that directs the computer to perform a specific series of operations (often to solve a specific problem). (27, p. 304)

**Data: Any representation of a fact or an idea that can be communicated or manipulated by some process (27, p. 292).

very small units. An example is the Memory Module of MI^2 Data Systems of Columbus, Ohio. In the words of the President, Joseph Marsalka, "A case in point is our newest product - the Memory Module. Designed primarily to operate with a wide variety of input/output devices such as Teletypes, CRT display units, thermal printers, etc., the unit stores messages electronically, allows the stored information to be edited or changed as required and then transmits the data over standard telephone lines at data rates up to 4800 baud. The Memory Module is virtually a micro-computer. It is fully solid state and uses neither magnetic drum, disc nor tape for data storage. The Module can store up to 7500 characters in its 13 by 12 by 5 inch case." (17, p. 22) A micro-computer of this general type can be programmed to accomplish many routine computer operations, solve agricultural type problems, and also be used as a terminal when information or greater computation capability is required from a central computer system.

For agriculture, the potential use of "traditional" computers, mini or micro computers, and various types of time-sharing is totally dependent on the dreams and imagination of agriculturalists. In the near future, many farmers will probably have time-sharing terminals in their homes. These will range from fairly sophisticated systems with built-in computation capability down to the touch-tone telephone. For computer programs requiring a minimum amount of input and output, the touch-tone telephone is already in service as a terminal for some farm management problems. Michigan State's Teleplan system is designed to be accessed by touch-tone telephones. Data is entered through buttons on the telephone and answers given over the telephone by voice response. The computer has a 5000 word audio vocabulary that is adequate to provide answers to most of the programs on the teleplan system. Dr. Marsalka informs me that there will soon be available portable typewriters that will be able to edit text and act as computer terminals. The television set is also being used as a computer terminal. Within a very few years, farmers in most countries, will have several types of computer terminals readily available to him through normal household equipment (typewriter, television set, and touch-tone telephone). I suspect that it will not be long before the average farmer will interact with the computer for aid in decision making as simply and easily as he uses any other tool in his business. An example might be a farmer who finds disease in his soybeans. He might well take a few stalks of the diseased plants into his communications center (typewriter and color television set), dial up the computer and ask for a program on plant diseases. The computer would quiz him on the type of plants, etc. Then the computer could show pictures of various diseased soybean plants on color television until a match was established. Once the match was established, audio visual tape could be started by the computer, transmitted over the telephone circuit to the television set, and the farmer would receive a discussion on the disease by a trained professional agriculturalist in living color. The above is just one of a thousand ways in which the farmer might well interact with the computer in problem solving.

The future holds exciting developments for computers that will make them even more useful and cheaper for farm managers. Within ten years, we can expect such technologies as oral input, and both data memory and transmission by lasers (35, p. 307). Laser technology will increase the speed of computers by a factor of at least 1000. Laser memory will greatly reduce the cost and space requirement for storing both computer programs and data. It is estimated that one billion characters of information will be stored in an area the size of a postage stamp. This contrasts with the first generation computers wherein it took almost a room full of vacuum tubes to store one thousand characters of information. Widespread development of laser memory might well eliminate the need for many of our libraries. It takes approximately 500 five hundred page volumes of information to produce one billion characters. If these five hundred volumes can, in fact, be stored in an area the size of a postage stamp, it becomes easy to see that everything written in the history of mankind could be stored in a relatively small area, perhaps in less space than the vacuum tubes required to store one thousand characters of information just twenty years ago. Oral input to computers would make their capabilities available to almost anyone.

COMPUTERIZED FARM BUSINESS ANALYSIS

Computers have been instrumental in improving our capability in analyzing farm businesses. Those who have been involved have undoubtedly experienced frustrations. In the early days of computers, it seemed that once satisfactory results were obtained, computer centers (university, business, or service bureaus) would either change equipment or operating systems and reprogramming was necessary. Fortunately these adjustments have become less painful over time. Advanced computer simulation* and emulation** even allow us to use programs designed for one computer system on other systems with minimal or no reprogramming.

A trend, and to my mind a very positive one, has been to move away from the concept that every state or perhaps county needs to have its own farm business analyses system. One computer center, in many cases, is now doing the computer work for several states. In Ohio, for example, when a farmer wants a monthly accounting program, we encourage him to use ARC (Agricultural Records Cooperative) at Madison, Wisconsin; Production Credit Association, or

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*Simulate - To represent the functioning of one system by another; for example to represent a computer or a physical system by the execution of a computer program, or a biological system by a mathematical model (27, p. 307).

**Emulator - A device, usually used in conjunction with special programmed routines, that enables one computer to execute machine-language instructions intended for another computer dissimilar in design, without prior translation (27, p. 293).

some other record system. These systems do the records of farmers from a widespread area resulting in much lower costs per unit processed. We do have a Year-End Farm Business Analysis program that is processed by our own University computers. This program was developed internally only because another system, at comparable costs that would meet our objectives, was not available. Now that this system is developed, the records of farmers from other states could also be processed if the program met the objectives and needs of those farmers and states.

In Ohio, we have set up our farm business analysis to evaluate farms on the same basis as other types of businesses. Much of the terminology is that of the business world. Terms that were unique and necessary for understanding agriculture were retained. There are two aspects to the Ohio analysis: (a) Individual farm business analyses, and (b) state summaries. In brief, individual analyses includes collecting information from farmers, submitting the information to the Ohio State University for checking and processing, and returning an economic analysis of the individual farm including separate evaluations of each enterprise to the farmer. For each of the farmer's enterprises, we include his profit margin, turnover, and return on investment. After the individual analyses are completed, they are combined in state summaries. Presently five separate state summaries are prepared: Dairy, Dairy by Herd Size, Swine, Beef and Crops. The state summaries include information on different classes of farms according to performance. A farmer can compare information on his farm against the top 10 percent of the farms in the state, top 25 percent, mid 50 percent and lower 25 percent of his category of farm. Copies of these summaries are available to you if you so desire.

In the future, I see these analyses and summaries approximating even more closely similar analyses for the business world. Using the terminology of the business world will facilitate interaction between agriculturalists and those trained in business schools. As time progresses, financial institutions might well require detailed financial business analyses from farmers as a prerequisite for doing business with them.

COMPUTERIZED DECISION MAKING

Feed blend linear programming was and still remains the classic use of computers in agricultural decision making. In the United States, as an example, most manufactured feed is formulated on the basis of computer solutions. The use of this technique is spreading around the world. In most feed formulations, several hundred thousand calculations are required to determine the best combination of feed ingredients to meet all nutrient and palatability requirements for a given performance level at the least possible cost. The technique has meant millions of dollars annual savings to those feed companies and farmers using it. Not only is money saved, but nutrition improved. If the basic data matrix is proper, the farmer or nutritionist can

be highly confident that the computer formulation is properly nutritionally balanced. Over the past two years, which have seen wide variations in both prices and availability of feed ingredients, savings have been much greater than usual. Savings over traditional corn-soybean rations have been reported as high as $50.00 per ton. Nutritionists (commercial, university, and government) have reported that the computer has beat their best "Pencil" figures by an average of one to five dollars per ton.

Feed blend linear programming has led to the development of more exotic uses of the computer in blending based on the linear programming principle. One of the first expanded applications was the Slide Weight or Optimal Density Feed Blending principle. This technique formulates feeds to least-cost of nutrient density rather than to weight and normally provides an additional savings of two to three dollars per ton of feed equivalent produced. Research has shown that monogastic animals (poultry and swine) will alter the amount of feed ingested to their caloric requirement as long as the diet is properly balanced, over a fairly large range. Many companies and farmers in the United States are using this principle to economic advantage (33).

Another very powerful technique is "Parametric Cost and/or Nutrient Ranging". This technique can be of tremendous value to the feed blender, feed supplier, researcher, and educator. In any given competitive situation, where feed blend linear programming is used as the decision tool, it can determine the total price/quantity (demand curve) of a given ingredient (4, 37).

Feed blend linear programming, the optimum density technique, and parametric cost and nutrient ranging benefit farmers both directly and indirectly. Directly, the farmer often has access to the techniques through the cooperative extension service and/or individual feed companies. One example in Ohio is William Newland, a nutritionist at our Fremont extension center, who works directly with farmers. He utilizes the techniques through the College of Agriculture's ACCESS system. First, Newland asks the farmer to have his home-grown feeds analyzed through the University's "Ration Evaluation Program". Next, the quantities and prices of various feedstuffs available to the farmer, both home-grown and commercial, is determined. This information, based on the individual farmer's situation, is fed into the time-sharing computer system and results immediately typed back on the terminal. On several dairy operations, Newland has helped farmers realize savings of ten to thirty cents per head per day over their previous operation (from $3,650 to $10,950 per year on a 100 cow operation). Similar savings, adjusted according to feed intake of animal, have been realized for other classes of livestock and poultry. Newland has also used the parametric techniques to good advantage to make cropping recommendations to farmers both individually and as a group (34). Several individual feed companies in Ohio also do custom blending for farmers based on individual computer runs where the data has been adjusted to reflect the farmer's unique situation. This direct interaction with farmers on feeding programs, by both the cooperative extension service

and individual feed companies, is being carried out within many states. Even where direct interaction is not available, these techniques often aid the farmer indirectly. Feed companies effectively using the techniques can mix feeds at lower cost than equivalent mixed feeds where the computer was not used. Realized savings are often partially passed on to customers.

Optimum Resource Allocation or "Blend of Blends" is a technique wherein several feed formulations can be solved simultaneously within ingredient inventory constraints. Put another way, the computer will divide up available inventory in such a manner that each limited ingredient will be used in those diets and in those amounts that will yield optimum economic returns. Programs are presently available wherein the feed formulator can inform the computer which ingredients he has available, their quantity and price; which other ingredients, or additional amounts of the same ingredients can be obtained on an emergency basis, their quantity and price; the maximum and minimums of each feed required; the selling prices or values of finished feeds; and the maximum and minimum inventories of ingredients that must be left after the solution. With this information available, the computer determines simultaneously the optimum amount of each feed to produce along with the least-cost formulation of each. This program can move a feed business considerably along the road toward total profit optimization of the firm. This procedure, to my knowledge, was first developed by James C. Snyder and others at Purdue University, but is presently available through at least one vending company on a time-sharing basis (36). While this technique does not have as much direct application to the individual farm situation, improvements in feed mill efficiency usually means lower costs to farmers than would otherwise prevail.

These blending techniques not only increase profits to farmers and other organizations using them, but also greatly improve the utilization of scarce nutrients. Nutrients are distributed more efficiently among competing classes of livestock. These savings of nutrients eventually mean more people can be fed from the scarce resources of the world. Proper application of these techniques has the potential of decreasing starvation.

Other programs coming into being for the animal production industry are: Feed blending based on prices and other marketing conditions associated with the final product, economic projection models on various classes of livestock, feed-lot close-out*, etc. Each of these tie together the economics of physical relationships.

The animal production industry was chosen, as an example, for demonstrating the computer as an aid in decision making simply because the techniques are more fully advanced and have had a greater economic impact than in other

*Feed-lot close-out is a term used by the cattle industry referring to accounting used to determine profitability as well as economic and physical efficiency factors associated with given lots of cattle.

sectors of agriculture. Results are measurable. Also companies who have chosen to offer technical computer services are more visible in this area.

In addition to the farm business analysis programs and animal production techniques previously discussed, a large number of other computer accessible programs have been introduced to the agricultural community. For the United States, Buel Lanpher in his latest "Inventory of EDP Programs Used in Agricultural Extension" (31) provides brief descriptions of 425 computer programs reported by 47 states and Puerto Rico. This does not mean that there are this many individual, different programs available. The 425 list many duplications from state to state and some of the programs apparently interlock with other programs. "The Inventory reports that the 425 programs were utilized to the extent of approximately 67,848 runs during 1972." (30, p. 932) These programs include such techniques as farm accounting and business analysis, farm optimization linear programming, farm simulation, budget generators, the above enumerated feed programs, financial management packages, fertilization recommendations, and weed and insect identification. The most popular programs, in number of runs, remain farm accounting and business analysis and the feed blend type of programs previously discussed. Some of the programs are available through time-sharing; most are available through batch processing. They are practically all directly available to farmers in helping them operate their businesses. Some programs such as farm optimization linear programming and simulation require considerable effort in basic data preparation. Consequently, they have been primarily used for research. When used in extension, most states have justified the resource expenditure by seeking relationships upon which general recommendations could be made. The development of budget generators and other recent technology, however, may reduce the cost in resources to where the average farmer could justify their use.

COMPUTERIZED PURCHASED, UNIVERSITY, AND GOVERNMENT COUNSELLING SERVICES

Computerized Purchased Counselling Services

The advancement of computer technology has created the opportunity for companies to specialize in researching, developing, and maintaining application types of computer programs for agriculture. For illustration purposes, several of these companies will be briefly discussed.

DHI Computing Service, Inc.; Provo, Utah, USA

According to Bliss Crandall, the first system for mechanical tabulation of DHIA records for use on the farm was developed in 1950 in Logan, Utah by himself and Lyman H. Rich, then staff members of Utah State University. DHI Computing Service is an outgrowth of that system and is now a private company owned by Mr. Crandall. Since its inception, the company has limited its DHIA service to the official programs in the various states it serves. In August 1972, records were processed for more than 460,000 cows in approximately 4700

herds in over seventeen states, Mexico, and Columbia. Without the active participation of the Extension Service, in the states it serves, and the United States Department of Agriculture, DHI does not consider the tabulation of DHIA records a good business risk. A certain size or scale is essential for a system of this nature to run effectively. Experience in the United States has seen the number of DHIA processing centers decrease with more and better services performed by those remaining. DHI Computing Service, as one example, is continually expanding its capability in analyzing records for farmers (6).

Cattle-Fax; Denver, Colorado, USA

Cattle-Fax, which became operational in late 1968, was established by the American National Cattlemen's Association to develop and implement a marketing program which would provide cattlemen with current marketing information as well as market projections on which sounder marketing and management decision could be made. This program is nationwide in scope and should become increasingly useful to the American Cattlemen (22).

Computone Systems, Inc.; Atlanta, Georgia, USA

Computone Systems came into operation under the name of Computrol in 1965. The company was reorganized in 1969 as Computone Systems. To my knowledge, Computone was the first company that offered specific computer programs to agriculture as aids in decision making through teleprocessing. Their initial application was in the least-cost formulation or formulas for the animal and poultry feed industry, and for emulsion products--weiners and bologna--for the sausage industry. In its next step, Computone offered a market service to the iced-pack broiler industry from 1968-1970. This service was offered to all producers and processors, whereby production and marketing information was transmitted to the Atlanta center. Information was then summarized for various areas of the country and made available to all subscribers. An audio-response system on the computer provided the user with a voice response rather than a printed reply. In addition to agriculture, Computone has expanded its services to other segments of the business world, concentrating primarily on financial and analysis information to the business world. It is now, however, taking its financial planning services to the agricultural industry. Computone operates its own computers and all teleprocessing procedures require unique computer terminals that are manufactured by Computone (18).

Maddy Associates, Inc.; St. Louis, Missouri, USA

In 1968, the Monsanto Company, through the Computerized Technology Department of the New Enterprise Division, began offering a series of "Computer decision-aid programs" to the Animal Production Industry. Monsanto used a commercial time-sharing company (Com-Share) as its delivery

vehicle. Standard computer terminals (mostly inexpensive teletypes) were used. With this system, the customer not only had access to the speciality programs offered by Monsanto, but the full facilities of the time-sharing utility company. If desirable, the agriculturalist could use the Monsanto speciality programs, the utilities library programs, and do his own programming. Monsanto very rapidly expanded their services throughout the United States, Canada, and Europe. In September of 1971, Monsanto sold its system in the United States to Maddy Associates, Inc. Kenneth H. Maddy, who is president, was one of the primary developers of the system at Monsanto. In Europe, the system was sold to the Hoffman La Roche company in Basel, Switzerland. This system introduced several advanced problem solving packages to the general public via teleprocessing such as Parametric Cost and Nutrient Ranging, Feed Inventory Control, and Optimal Resource Allocation (15).

SCIDATA; Atlanta, Georgia, USA

SCIDATA was founded in November, 1969 and installed its first systems in 1971. SCIDATA was founded by William T. Glover, who is President and Chairman of the Board. Mr. Glover is the individual who first started Computrol Systems which was discussed above. He left Computrol when it was reorganized in 1969 as Computone Systems to start SCIDATA. SCIDATA specializes in a compact, totally self-contained, computer system. It is a "turn-key" system in that SCIDATA not only provides the computer hardware, but also the applications programs, and the training needed to operate the system. This system was especially attractive to those agri-business firms that had been doing a lot of work on "Teleprocessing" systems which resulted in high communications costs. Several large American companies have installed the SCIDATA system to allow their nutritionists the convenience of their own turn-key system without the losses in efficiency formally experienced by long turn-around problems with in-house computer systems, primarily used for "bookkeeping" operations. The SCIDATA system is compact, fast, and versatile (20).

Management Horizons Data Systems; Columbus, Ohio, USA

Management Horizons was founded in 1969. It designed and developed unique on-line data processing systems for distribution centers and retailers. By the fall of 1972, Byron L. Carter, President, reported they were serving more than 120 companies in 40 states and parts of Canada. Food distributors were an important portion of the total. In their data-line network, each subscriber is linked directly to the central computer installation in Columbus and each uses this installation as though he were the sole owner or user (5).

The above are examples of commercial firms that have developed specialized application computer programs to serve agriculture. The future will undoubtedly see many more come into existence to serve the various sectors of the agricultural economy. The research and development necessary to make

these systems available to agriculturalists are usually very expensive. Most of them are quite frankly beyond the reach financially of the average agriculture firm. By developing and offering these systems to a multitude of users, however, the expensive research, development, and even maintenance can be shared by many and still provide a reasonable profit to the firm offering the service. It is of interest to note that large agricultural firms are often the first customers of these specialized services. It's simply cheaper and more efficient to be a customer than an owner.

Other Private Firms

In addition to the above discussed firms, many time-sharing computer utility companies have programs in their libraries with direct application to agricultural decision making. For example, General Electric, I.B.M. Call 360, the INFONET Division of Computer Sciences Corporation (14), Com-Share (7), Computer Complex, On-Line Systems (23), and United Computing, have all had directly applicable programs. In general, utility companies have not offered as much in-depth counselling as the companies discussed previously, but they have offered valuable capability and continue to do so. They also provide computer time-sharing delivery systems for individuals, firms, universities, and governments that do not want to get into the computer hardware business. With worldwide, efficient, time-sharing utilities, it is hard to justify the installation of time-sharing computer systems by those desiring to provide a "service" to agriculture.

The Private Counselling Company and the Farmer

The systems discussed above, with the exceptions of DHI Computing and Cattle-Fax, were primarily developed for agri-business. This is also true for the systems developed by companies not mentioned. Some very large agricultural operations and farm management firms are large enough to become customers of the services, but most individual farmers are not. The farmer, however, can and often does become a third party beneficiary of the system. Agri-business firms, universities, and government units are large enough to become attractive customers to the vending companies. The services offered are then, on many occasions, passed on to the farmer. In Ohio, for example, we use the Maddy programs in our ACCESS system. Georgia uses Computone in their poultry extension program. Many states use DHI Computing. Agri-business firms use services of the vendors in working more effectively with their farmer clientele.

Computerized University and Government Counselling Services

Universities, in cooperation with government, have for several years aided farmers with such computer related activities as electronic accounting, farm business analysis, Optimization Linear Programming, etc. (Note the 425 programs documented by Buel Lanpher discussed previously). Very often computer programs, both for batch and time-sharing, developed by one university are available for use by other institutions. As examples, Oklahoma State and Purdue will sell copies of some of their programs at a nominal

fee; Minnesota provides copies of certain programs free; Wisconsin has adapted a Minnesota program and loaded it on the Michigan State Telplan system which operates on the University of Michigan computer system and is available for use to those universities subscribing to Telplan. This capability of sharing computer programs has been considerably expanded recently through teleprocessing. Most universities using teleprocessing are still interacting with their own in-house computer systems. At least two universities, however, Michigan State and Virginia Polytechnical Institute, have developed comprehensive systems that they have made available to other Educational Institutions. By ACCESSing these systems, an institution can avoid the high research, development, and maintenance costs involved with teleprocessing systems.

Michigan State University; East Lansing, Michigan, USA

The major thrust toward developing a comprehensive teleprocessing system began at Michigan State University in 1967 with the help of financial support to the Agricultural Economics Department from the Kellogg Foundation. Michigan State's present system operates through the University of Michigan's computer system at Ann Arbor. TELPLAN (the name given the computer program library and delivery system in Michigan) provides a multitude of decision type application programs useful to farmers through the time-sharing environment. Several states including Wisconsin, Minnesota, New York, Illinois and Ohio, actively use the Telplan system in their extension education programs. Cooperating states have developed some of the programs and cooperated in the development of some of the other programs on the system. The feed-blend linear programming programs have been the most popular to date. The system has both printer and voice response capability (26).

Virginia Polytechnical Institute; Blacksburg, Virginia, USA

In 1969 a joint project of Virginia Polytechnical Institute and the Federal Extension Service was set up to study the feasibility of Extension to use remote computer systems to make computer capabilities available to decision makers in localities removed from the computer center. The first year or so the system was developed on V.P.I.'s own computer system; it did not prove satisfactory. Presently the Virginia system is known as "Computerized Management Network - A Remote Interactive System for Education". The operating system and applications programs are loaded on "Online Systems, Inc." Online Systems is a computer utility company located in Pittsburgh, Pennsylvania. Several states, in addition to Virginia, are making use of this system and the library of farm management orientated programs in its library.

This recent movement of universities to make applications types of computer programs available to agriculturalists beyond their own borders is a most positive development. Perhaps it will help lessen the enormous expenses involved with the traditional institutional approach to "Reinventing the wheel".

The introduction of problem solving systems through computer time-sharing and the national and international computer utility companies offer intriguing possibilities. Program development too costly for an individual state to justify for use within that state alone may easily be justified when used on a regional, national, or international basis (23).

Ohio State University; Columbus, Ohio, USA

At Ohio State University, we started a system called ACCESS in the summer of 1971. ACCESS is an acronym for Agricultural Community Computer Educational Satellite System. Fortunately our administration, more specifically David H. Boyne, who is chairman of the Department of Agricultural Economics and Roy M. Kottman, Dean of the College of Agriculture, were progressive so that "Reinvention of the Wheel" was not necessary. The ACCESS system in Ohio utilizes programs developed by other universities and by private industry. We contract for use of the Maddy animal production programs (15) ACCESSed through Com-Share, Inc., (7) and for use of Com-Share's standard library programs, including a comprehensive set of business management programs. Secondly, we utilize the TELPLAN system of Michigan State University (26) and also the Computerized Management Network of V.P.I. (23). In addition, we use some programs developed at Ohio State that can be used through our own Computer Systems, and also we have developed a limited number of programs, that apply to specific Ohio operations, on the Com-Share system (2). By becoming one of a number of users on the above enumerated systems, we at Ohio State have been able to develop a most effective program at a very reasonable cost. We are convinced that to have developed equal capacity through the usual "in-house" approach would have required many years and probably millions of dollars. For a fraction of the cost, we have full capacity with a fraction of the problems. We were also able to achieve immediate operational capability upon acquiring a computer terminal and making arrangements with the proper companies and universities for ACCESS to their systems.

For the first year, we operated ACCESS directly from the University using it in our extension, research and teaching programs. In extension, we made over 150 demonstrations throughout the state of Ohio without experiencing a single failure. Every time we attempted to operate the system, we were successful. Some of these demonstrations were made on kitchen tables, in motel rooms, garages, phone booths, etc. Anywhere a telephone was available, we were able to operate. In September 1972, we installed our first permanent field terminal at our Fremont extension center. The extension specialists at Fremont have been most pleased with ACCESS as a vehicle in furthering their programs. We are now in the process of extending ACCESS to our other area centers. This past year the College of Agriculture developed a program that proved to be very popular with the young people of the state. Terminals were set up at the State Fair and at our "Farm Science Review" to help young people with planning their academic careers. The computer would ask the potential students personal questions,

educational objectives, area of interest, etc., and then would type back a personal letter making education recommendations and sign the letter "CASY, your friendly computer". Needless to say, the operation was most popular. We have also been pleased with ACCESS as a research vehicle and as a classroom instruction tool.

The advent of teleprocessing and time-sharing has real potential for agriculture. Perhaps the not-to-distant future will see agriculturalists from all over the world ACCESSing common computer applications programs and data banks through the usual communications networks (telephones, satellites, micro-waves, etc.). The possibilities of the future are most intriguing.

COMPUTERIZED DATA BANKS

Buel F. Lanpher, Program Leader, Farm Management, ES-USDA, along with agriculturalists worldwide, has believed in computers as aids in communications since their inception. He feels that remote terminals (or computer satellites) capable of connecting with computer centers across the United States (and conceptionally the whole world) are probably going to have more impact on the nature, quantity, and quality of Extension programs than any single factor in Extension's history (13). This concept is as true for research, teaching, and industry as for Extension.

To date, the only types of data banks* that I am aware of that have been designed for agriculturalists that are accessible through time-sharing on a continuous basis are those with a high value pay-off. The most notable of these and most common are those having to do with feed blending. The use of these data banks has high economic impact to their users. Several of the vending companies discussed previously provide access to speciality data banks to their customers. Michigan State offers direct access to data banks on herbicide and fertilizer recommendations, disease recognition, etc. Other states and institutions also have speciality type data banks directly accessible. Most large data banks, however, for agriculture are still stored on other less expensive media.

Vast amounts of information are presently stored on magnetic computer tapes and punched cards throughout the world that could quickly be placed on time-sharing computer systems as soon as inexpensive direct access storage becomes available. An example would be a huge data bank being developed by Dr. Lorin E. Harris and his colleagues at the Utah State University, which contains nutrient and palability characteristics of feed ingredients on a worldwide basis. If this data bank were available through time-sharing,

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*Data bank as used in this paper refers to information and not to computer programs. Computer programs are necessary to direct the computer in obtaining stored information, but the term "data bank" refers to information and not computer programs.

agriculturalists worldwide could create animal nutrition data banks for their unique situations in a minimum of time. This is just one of what I assume are hundreds of examples. The breakthrough in providing time-sharing access to vast data banks is dependent on the development of high speed direct access storage devices for computers. Probably laser storage is the key.

PROBLEMS

It is evident from the foregoing presentation that I am personally very optimistic as to the future of computers in agriculture. In fact, I would have to agree with Charles E. French when he says, "Historians may not fully concur, but certain engulfing urges seem to sweep through our economic and social system from time to time. These become societal prime movers. Some such urges can be identified, e.g., the urge to explore, the urge to mechanize, the urge to organize, the urge to accelerate, and the urge to socialize. Two or more of these may interface at times. Cybernetics seems to be such a prime mover balanced on modern urges to industrialize and accelerate. In this sense, it is profound and powerful among events of our time and has influenced agriculture positively." (10, p. 139) French defines cybernetics as encompassing the whole field of computers, information, and control. While recognizing the power of the computer as a positive force in agriculture, it is well to recognize problems that exist, at least at the present.

Richard D. Duvick states, "One problem to all three systems we are using in Ohio is lack of documentation. This represents the greatest single obstacle in using these programs in either an educational or individual service phase. Most all programs have a description of sorts, general objectives, order and type of input data and some support data. In every case, there is sufficient information to plug in numbers and get answers back. And for programs that answer simple questions, no further documentation is needed." (29, p. 4) The real lack in documentation is in describing the logic of the programs, what they can do for the user, and how to correctly interpret the computer output. Documentation, while a problem, is continually improving. Some states are working together on manuals and other descriptions to make programs more meaningful to individual farmers. The need for good documentation is recognized and progress is being made.

A second major problem is lack of education. Very few working agriculturalists, let alone farmers, have had any training in basic computer technology or logic. The computer is a foreign world to most. One notices a good deal of polarization concerning the computer. On the one extreme is the group that thinks the computer has inherent magic powers that enables it to solve any type of problem. The other group discounts it completely as an effective tool in decision making. A positive development is the

trend of the Colleges of Agriculture to introduce basic computer courses in their curriculum. At Ohio State, as an example, we offer a course at the sophomore level entitled "Computers in Agricultural Decisions". Student acceptance seems to be excellent. Other universities are now teaching similar courses. As students who have taken these classes become available to the job market, it is to be anticipated that computers will be more effectively understood and used in agriculture. As to extension field staff, Duvick states, "Training and involvement of field staff is a long-term ongoing process. Interest in the program is quickly generated. Learning the mechanical process of running most programs can be learned in a short time. But gaining understanding of and confidence in the programs and their inherent logic is a much slower process . . . Staff personnel -- be it state, area or county, in Agricultural Economics, Rural Sociology, Animal Science or Home Economics -- will not use the programs until they understand them." (29, p. 8) Education, while a problem with any new technology, will eventually be resolved.

Ludwig M. Eisgruber feels that the critical issue in the United States is the development of a comprehensive concept of managerial information and decision systems. He states, "The development of a comprehensive concept of an information system will not necessarily result in the development of one operational system. Instead, it is more likely that the comprehensive concept will lead to the conclusion that, due to differing circumstances, different operational systems are appropriate and that the pursuit of the one definite operational system is not as productive as the concentration on individual improvements. However, the comprehensive concept will aid in deciding which of the many possible individual improvements should receive priority." (30, p. 933)

In Canada, George E. Lee and Raymond C. Nicholson, conclude, (a) "There is at present no operational framework upon which a wide variety of MIS* can be evaluated...", (b) "In regard to who pays the cost of obtaining information, the value of information to the individual must be analyzed relative to the value of that information to society. Farm data may be similar to research data in that, in some cases, the individual is not justified in obtaining it while society may be.", (c) "When the major components of MIS in Canada are looked at in total, there appears to be a relative over-capacity in the data system stage compared with the data recording and decision system stage.", (d) "The most serious defect in the structure of MIS for agriculture in Canada is the large number of independent components and institutions within components that make up such a system.", (e) "The second most serious defect in the operation of MIS in Canada is the lack of development in the conceptual area." (32, pp. 928-929)

Evaluating the utility of various programs to farmers and farm managers is often frustrating. For some programs, such as feed blending, fairly accurate dollar figures can be obtained. For others, such as farm accounting and business analysis, budgeting, informational retrieval, and spray

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*MIS stands for Management Information System.

recommendations, monetary figures are difficult or impossible to obtain. We should also be aware that an appraisal of specific data tends to overvalue that data as potential information. This is so because the "real" value must be related to the next best source. The "next best source" is often overlooked.

If I may be so bold as to state a general concensus as to problem areas, I would have to say that the problems exist in implementation of computers and related technology to agriculture, rather than to their capability and potential as effective tools. Problems having to do with documentation, education, evaluation, comprehensive concept, coordination, conceptualization, etc. exist with every technology. They have perhaps been accentuated in the area of computers and related technology due to the rapidity of development and introduction. I am confident that these problems will be overcome with time.

SUMMARY AND CONCLUSIONS

Computers are an established fact in agriculture. They are here to stay and will play an increasingly important role in the future. One could almost say that a computer will be come an indispensable part of your "management tool kit" or you will become a dispensable part of agriculture. It is not enough for the farm manager to think only of bridging the technical and management gap that exists today. To be successful, he must be thinking five, ten, and fifteen years into the future. He should evaluate very carefully the various methods by which he can utilize computers. After careful evaluation, he should choose the method or combination of methods that best meet his needs and budget. The most expensive way is not always the best. Overly fancy computer facilities and uses can lead to the poor house just as rapidly as complete lack of computer capabilities. Above all, the computer world is dynamic. One must always be ready to accept new ideas and concepts. On the other hand, the computer must be treated as a tool. Let it be the servant, not the master. It doesn't do the thinking, but acts in organizing basic information for decision making.

Computer applications are growing in number and complexity. They will continue to do so, only at a faster rate. One positive factor, however, is technical sharing, wherein companies, universities, and government develop special programs in the language of the agriculturalist and also supply necessary counselling services to enable the agriculturalist to use these applications easily.

Efficient use of the earth's resources in the production of food and fiber is essential to the well being of the earth's population. Computers as aids to decision making and information dissemination might be one important key to the problem of feeding the increasing numbers of individuals

being born. Farm managers certainly have a grave responsibility in meeting the energy and nutrient requirements of our present generation and the generations to come. Computers have the capability in helping us meet that responsibility. The technology is with us now. The question is and remains "How effectively will we use that technology in our day to day operations?" It might just be the key to survival for large numbers of people.

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